Expert Forum: Addressing Climate Risks for Coastal Transportation Infrastructure

A number of coastal communities around the world have experienced severe loss and damage due to extreme weather. In particular, transportation systems were disrupted and were unable to perform. Research by the Fraser Basin Council and others warn that British Columbia is also vulnerable to flooding and other extreme weather risks. Climate change and ongoing growth in the population will further challenge existing coastal transportation infrastructure in British Columbia.

The Expert Forum, organized by the Marine Environmental Observation Prediction And Response (MEOPAR) Network in partnership with the Institute for Catastrophic Loss Reduction (ICLR) and the Western Transportation Advisory Council (WESTAC), will focus on managing the risks associated with extreme weather, natural disasters, and climate change as they impact the movement of people and goods in coastal communities in British Columbia. Climate change is projected to increase the frequency and intensity of weather conditions that negatively impact Canada's coastlines. Sea level rise will amplify the impacts of storm surges, and severe precipitation events are expected to occur more frequently. The impacts on supply chain reliability, capacity and cost may be extreme - not just at the coast but across land-based, air and marine transportation systems. How should transportation stakeholders manage these risks? Can supply chains build, adapt and prepare for them? The forum is built around three core issues:

Can the lower mainland transportation infrastructure handle current extreme weather?

BC's lower mainland is home to Canada's largest port. The terminals, warehouses, railways, roadways and other supporting infrastructure keep Canada's economy moving. However, the nature of supply chains means damage to one link will have cascading impacts. In particular, recent global experience shows extensive economic disruption and losses as a result of coastal disasters. Business leaders and public officials must take action to reduce the risk of damage to transportation infrastructure from current climate hazards.

How should we manage the transportation risks for remote and island communities?

Coastal communities outside of the Lower Mainland, including Vancouver Island, are particularly vulnerable to disruption due to a greater dependence on ferries and a primary access road. Where transportation alternatives are few, service is infrequent, and distances are long, it is essential that coastal transportation systems do not fail or can be restored quickly.

What should be done to better prepare for future climates and rising sea levels?

Climate change is already impacting BC's transportation infrastructure. Higher temperatures, more extreme weather events, rising sea levels, and higher storm surges put our coastal transportation systems at risk. Moreover, these challenges are expected to increase over time. Taking action now to design and adapt infrastructure and services to future climates and sea level rise will build our resiliency to the effects of climate change and reduce the risk of loss, damage and disruption.

Background

British Columbia has a diverse transportation infrastructure in place. The marine infrastructure includes the busiest port in Canada and an active system of ferries. A number of airports are located in coastal communities, including Canada's second busiest airport. An active rail transportation system serves businesses, local commuters, and long distance travel. And the road transportation system supports local use, coastal communities, travel to the United States, and provides a gateway connecting British Columbia with the rest of Canada.

The infrastructure systems in British Columbia were designed and constructed over several decades. The climate at the time of construction may have been different than the present, and was likely much different than projected climate scenarios over the next 50 or 100 years. In particular, projections by the Pacific Climate Impacts Consortium (PCIC) at the University of Victoria anticipate warmer temperatures, change in precipitation and rising sea levels. There is important variation in the expected extent and significance of climate change across different regions of the province.

PCIC projects that the average annual temperature in British Columbia will increase by two to three degrees through to the 2080s relative to the historic average of the 1960s, 1970s and 1980s. Moreover, the average annual precipitation is expected to increase by 8 to 12 percent. This is expected to include a large increase in winter rainfall, a decrease in rainfall during the summer, and a 30 to 40 percent reduction in snowfall in southern and coastal communities Sea level is expected to increase by up to 1 metre due to climate change, which will represent a significant change for many BC communities.

Warmer temperatures can be a challenge for transportation infrastructure, particularly for older systems. Many road and rail systems were not designed to cope with extended heat waves. The expected increase in winter precipitation may include more extreme weather storms. Atmospheric rivers, sometimes referred to as the Pineapple Express, will bring periods of sustained heavy precipitation. Extreme rainfall frequently can overwhelm road and rail traffic in major urban centres, and has the potential to wash away critical transportation infrastructure across the province.

Rising sea levels represent an important challenge for British Columbia. Many critical transportation systems are located near the coast. This includes marine transportation systems, rail, and many roads, particular those supporting island and remote communities. Rising seas has the potential to overwhelm current systems. This may take place gradually, over a number of decades, or may involve extreme events like king tides and storm surge. Disruption may be temporary or could be sustained if critical systems are destroyed. Disruption will be evident locally, but extreme events can affect systems throughout the province and extend to have national and international consequences.

The Expert Forum will discuss the current state of knowledge about these issues and explore possible actions to reduce the risk of loss and damage from disruption of coastal transportation infrastructure. The science community seeks direction about research that would support the current and longer-term needs of decision makers.

A report summarizing the findings of the Expert Forum will be widely shared with decision makers across Canada with the goal of providing direction to new partnerships between the academic, public and private sectors.

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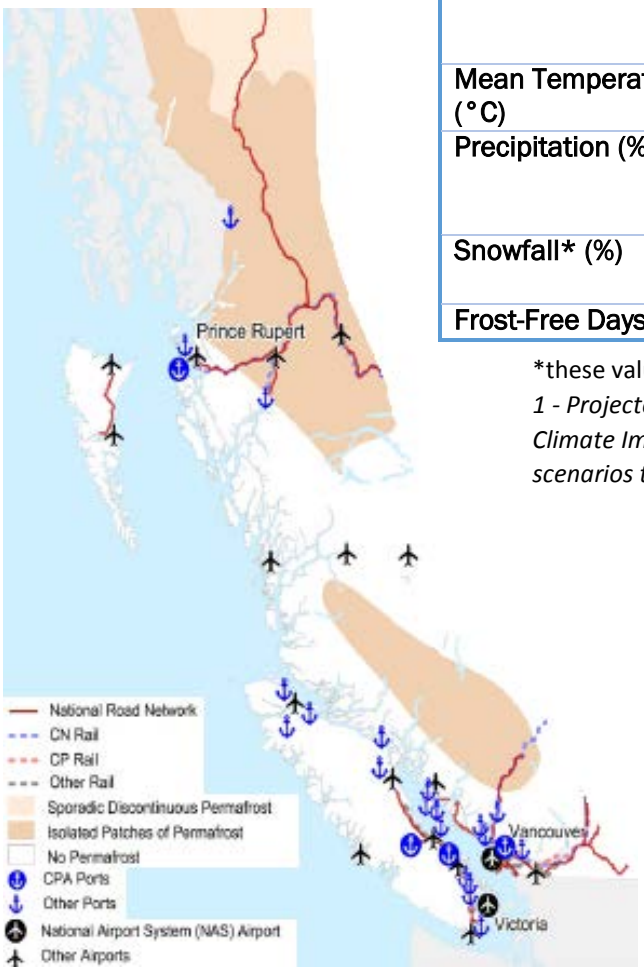
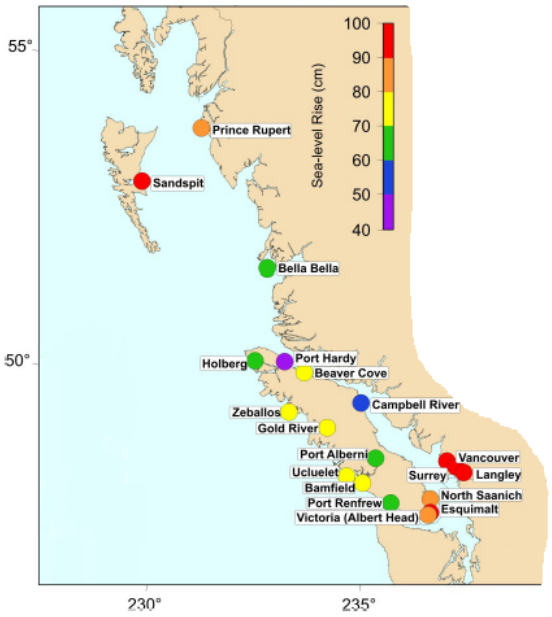
Principle transportation infrastructure in coastal British Columbia



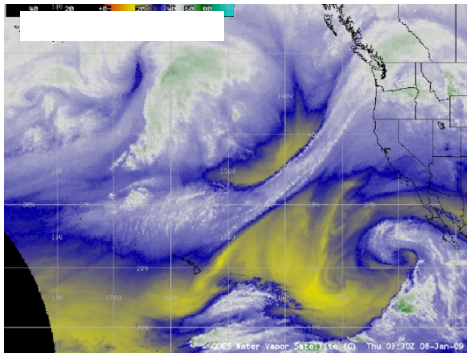
Projected changes of selected climate variables for B.C. Coasts in the 2080s[1]				
Climate Variable	Season	Projected Change from 1961-1990 Baseline (Ensemble Median)		
		South Coast	*West Coast*	*North Coast*
Mean Temperature (°C)	*Annual*	+2.7°C	+2.3°C	+2.6°C
Precipitation (%)	*Annual*	+9%	+8%	+12%
	Summer	-13%	-10%	+4%
	Winter	+10%	+9%	+13%
Snowfall* (%)	*Winter*	-33%	-38%	-6%
	Spring	-74%	-73%	-70%
Frost-Free Days* (days)	*Annual*	+37 days	+37 days	+34 days

*these values are derived from temperature and precipitation

1 - Projected changes are relative to the historic baseline 1961-1990 (Pacific Climate Impacts Consortium, 2013). Updated projections using the latest IPCC scenarios to be available soon on PCIC website (https://www.pacificclimate.org/)



Projections of relative sea-level rise for the year 2100 for the median value of the high emissions scenario (Atkinson et al., 2016).



Atmospheric River striking British Columbia on January 8, 2009. (Source: Cooperative Institute for Meteorological Satellite Studies / University of Wisconsin – Madison)

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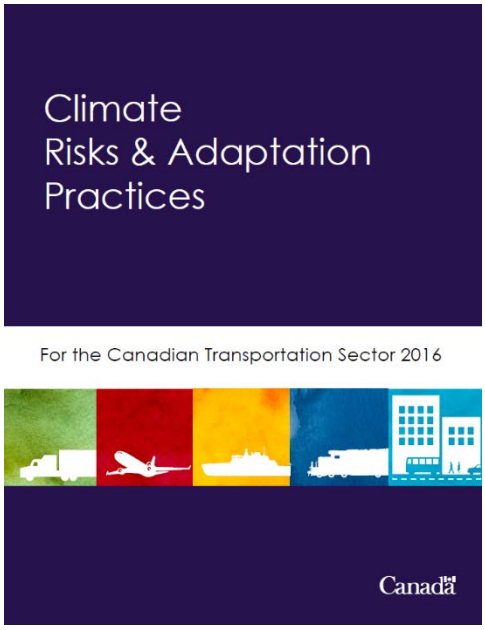
Key findings from *Climate risks and adaptation practices for the Canadian transportation sector*

National scale (http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2016/Chapter-2e.pdf)



- **Transportation infrastructure, essential to Canada's domestic and international trade, is vulnerable to damage and disruptions from a changing climate and extreme weather, and this can pose risks to other sectors of the economy.**
- **Climate and weather-related delays and disruptions to passenger travel could become more frequent in future.**
- **A changing climate is expected to result in some opportunities for Canadian transportation.**
- **Reactive approaches to managing climate risks (e.g., responding to past impacts or events), remain common in Canada's transportation sector.** At the same time, examples can be found in all regions, and for all transportation modes, of actions being taken in anticipation of future climate conditions.
- **Transportation decision-makers are increasingly adopting a risk management approach to reduce climate risks to their infrastructure and operations.**

British Columbia
(http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2016/Chapter-4e.pdf)

- **Transportation systems in British Columbia have demonstrated vulnerability to extreme weather and changes in climate.** Impacts of particular concern include those associated with:
  - Extreme precipitation, such as atmospheric river (Pineapple Express) events, affecting road and rail networks, marine transportation lanes, and airport facilities;
  - Sea level rise and storm surge, increasing the risks of flooding and damage to fixed coastal infrastructure, including Vancouver International Airport, Sandspit Airport on Haida Gwaii, and the Port of Vancouver;
  - High winds, affecting marine transportation lanes; and,
  - Visibility issues, affecting airport operations, particularly in the British Columbia interior.
- **Land transportation routes within British Columbia often occupy restricted corridors through mountains and along coastlines.** In these settings, flooding (associated with extreme precipitation or snowmelt) and slope failures have resulted in infrastructure failures to road and rail systems in the past. Events that have affected one of these modes have typically also affected the other.
- **While previous efforts to reduce climate risks to transportation systems were often reactive, and based on historical information, there is indication that this is changing.** Transportation entities are now inclined to become involved in broader future focused climate change studies and to incorporate these finding into their systems.
- **Climate change vulnerability assessments and revised and updated infrastructure design criteria can improve planning and adaptation efforts for British Columbia's transportation infrastructure.** The provincial government has conducted vulnerability assessments for highway systems and continues to monitor and assess sea level rise. The British Columbia Ministry of Transportation and Infrastructure is one of the first jurisdictions to require infrastructure design work for the ministry to include climate change implications.
- **Given the interconnectedness of transportation networks in British Columbia, there is opportunity to share research, risk analysis, and adaptation best practices across modes.**